AEI

Electrical Distribution

THE NEWS MAGAZINE OF THE CABLE AND CONSTRUCTION (CABLES & LINES) DIVISIONS OF ASSOCIATED ELECTRICAL INDUSTRIES LTD

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EDITORIAL

HERE IS THE first issue of our new journal ELECTRICAL DISTRIBUTION replacing *Distribution of Electricity* which completed thirty-two volumes since it first appeared in 1928. Thus DISTRIBUTION imitates the Phoenix and will, we trust, in its new form, be as well received as was its predecessor.

ELECTRICAL DISTRIBUTION is the news magazine of two of the A.E.I. Divisions—the Cable Division, which now combines the cable interests of three great companies: Henley's, Liverpool Cables, and Siemens Edison Swan, and the Construction (Cables and Lines) Division, which combines the interests of the construction and installation departments of Henley's and Siemens Edison Swan. It will bring you news of the products of the Cable Division, together with accounts of new developments and of interesting contracts carried out by the Construction Division.

In this issue will be found brief details of a new example of international co-operation—the cross-Channel power cable between France and Britain, contracts for which have just been placed by the C.E.G.B.

We are justly proud of our share in this important contract and we look forward to telling the story as it unfolds.

AEI

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OUR COVER PICTURE

Taken during a cable contract in Leicester for the E.M.E.B., our cover picture shows paper rolls being impregnated in preparation for jointing 0·6sq.in. 3-core 132kV oil-filled cables. The contract is described on page 3.

News in brief...

Lord Chandos at Harlow

LORD CHANDOS, chairman of Associated Electrical Industries, is seen with the transistorized "bell-push" transmitter which he used to unveil a commemorative plaque and thus open A.E.I.'s Harlow Research Laboratory (see page 7). The transmitter was afterwards presented to Lord Chandos by Dr J. N. Aldington, Managing Director of A.E.I. Woolwich group, for which the laboratory carries out research.

A.E.I. Cables at the New York Fair

A WIDE RANGE of cables manufactured by the A.E.I. Cable Division formed part of the varied exhibition of A.E.I. Ltd on their 1 300sq.ft stand at the British Exhibition in New York.

The chief cable exhibit was the 0·1sq.in. 3-core 33kV submarine cable supplied for off-shore oil-drilling rigs in Lake Maracaibo, Venezuela. Other cables on show included a sample of water-cooled cable, oil-filled super-tension cables, plastic-insulated cables, mining cables, and cables for railway electrification, telecommunications, and specialized industrial uses.

Another major exhibit on the stand was the A.E.I. electron microscope with image intensification, which enabled visitors to see on a television screen minute particles magnified more than a million times. This is an A.E.I. development, still in the experimental stage but sufficiently well advanced for it to be of use.

The most advanced marine radar equipment in use today—A.E.I. *Escort* marine radar—was seen in actual demonstration at the exhibition. Scanning equipment set up on the roof of the New York Coliseum projected a view of the Hudson and East rivers into the display stand for visitors to see.

More Supergrid Contracts for A.E.I.

THE ASSOCIATED ELECTRICAL INDUSTRIES Construction (Cables and Lines) Division has received two further contracts for the erection of 275kV overhead lines.

The contracts, totalling over £360 000, have been awarded by the South of Scotland Electricity Board, and cover two double-circuit steel tower lines with twin 0·4sq.in. S.C.A. conductors per phase. One, from Strathaven to Wishaw, is approximately 7¼ miles long and the other, between Strathaven and Neilston, approximately 19¼ miles.

Dungeness Nuclear Station

THE CENTRAL ELECTRICITY Generating Board has announced its intention to place a contract with the Nuclear Power Group, of which Associated Electrical Industries Ltd is a member, for Dungeness Nuclear power station. Dungeness is the sixth such station scheduled for construction in Great Britain.

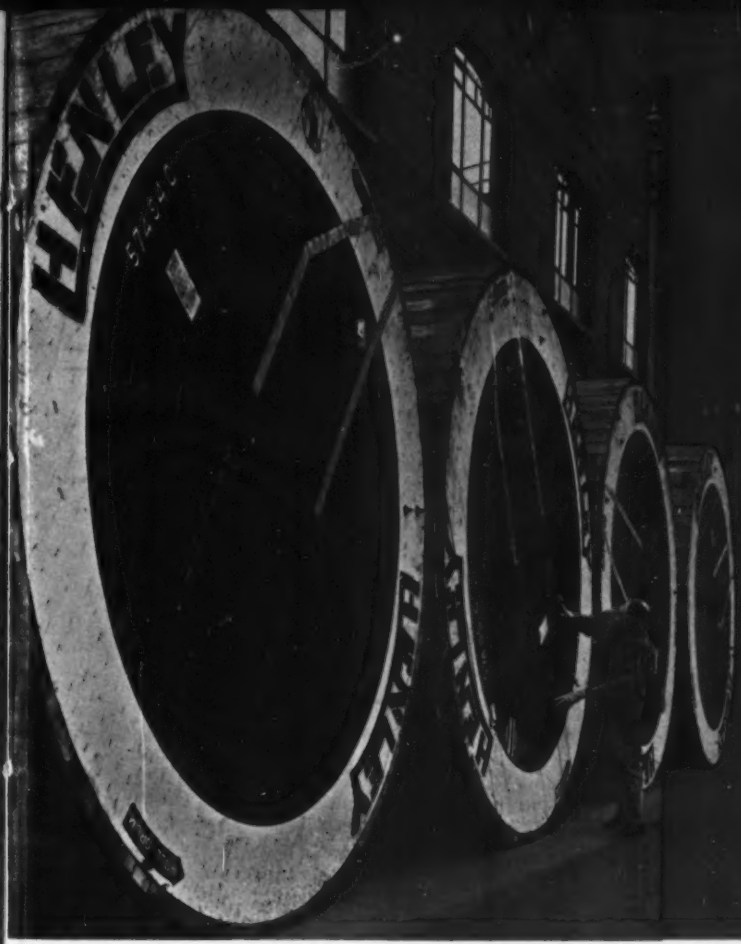
The station is designed for a net electrical output of 550MW and has two identical reactor units of approximately 840MW thermal output each, a turbine house, and the usual ancillaries. It will be connected to the 275kV supergrid.

Work on site will commence during August this year and the station will be completed and handed over to the C.E.G.B. in 1965.

E.B.N.I. Progress

THE TWENTY-EIGHTH Annual Report of the Electricity Board for Northern Ireland shows that the growth of the Board's system and generating capacity continues. Overall improvements in generating costs together with a "satisfactory increase" in sales of electricity and appliances with consequent spreading of overhead charges have resulted in an increased margin between revenue and working costs, despite increases in other costs.

Coolkeeragh Power Station, its associated 110kV transmission lines, and supplies to nearby new factories at Maydown, comprised the major part of construction work during the year. Investigations for the selection of a coastal site for a nuclear power station were also undertaken during the year. Reconstruction plans for new offices and showrooms or the erection of new premises went ahead. The provision of supplies to farms and other consumers continued at a steady rate, and sales of appliances reached a record total of £312 032, an increase of 71% on the previous year's figures and a striking confirmation of the wisdom of accompanying provision of electricity supplies with public exhibitions and demonstrations of labour-saving appliances.



A BIG ONE FOR LEICESTER

FOR THE PAST few months A.E.I. Construction (Cables and Lines) Division's engineers have been engaged on the supply, installation, and jointing of large duplicate 132kV feeder cables in Leicester—a job which is now complete. The cable, 4·85in. diameter over the serving, is the largest 132kV oil-filled supertension cable to come from the A.E.I. works at Gravesend. It is a 0·60sq.in. 3-core oil-filled cable with compacted circular copper conductors and aluminium oil ducts, single lead alloy sheathed and tin bronze reinforced, with protective serving.

Along with 8 000yd of feeders were laid combined pilot and telephone cables of $6 \times 7/{\cdot}029$in. plus 11pr polythene-insulated PVC.SWA.PVC sheathed construction.

The contract, valued at over £100 000, was awarded to A.E.I. Ltd by the East Midlands Electricity Board, who had planned the cable route through the busy streets of Leicester between Freeman's Meadow generating station and Blackbird Avenue. The scheme is to reinforce the electricity supply in the northern area of the city of Leicester and the work has been planned with a view to supplying a number of new 33kV major substations from the two 132kV feeders.

The 132kV cables were made at the Gravesend works of A.E.I. where the largest machines were employed in their manufacture. The illustration of the laying-up machine (next page) gives some idea of the scale of equipment required for the work. The conductors were compacted by a special technique and after laying up with the aluminium oil ducts and fillers the application of the lead alloy sheath by the straight-through press resulted in a diameter over the sheath of 4·25in. The anti-corrosion serving applied over the sheath increased the diameter to 4·85in. overall.

Routine testing of the individual cores and manufactured lengths was rigorously observed. Tests included the application of 172kV for fifteen minutes to each core, a power factor test up to 152kV (i.e. twice the working voltage to earth) on each core, and the normal copper resistance measurements. A 10kV d.c. test was also applied to the anti-corrosion serving at the works and after laying, to ensure its efficiency.

Manufacture of the thirty drums was completed without difficulty. Each drum of the cable weighed about twelve tons—a dominant factor in deciding the manufacturing lengths—and was 11ft diameter by 6ft wide. They were dispatched by road to Leicester, and cable-laying commenced from Freeman's Meadow generating station during early 1960.

Construction work was facilitated by the existence of the Construction Division's long-established Midlands'

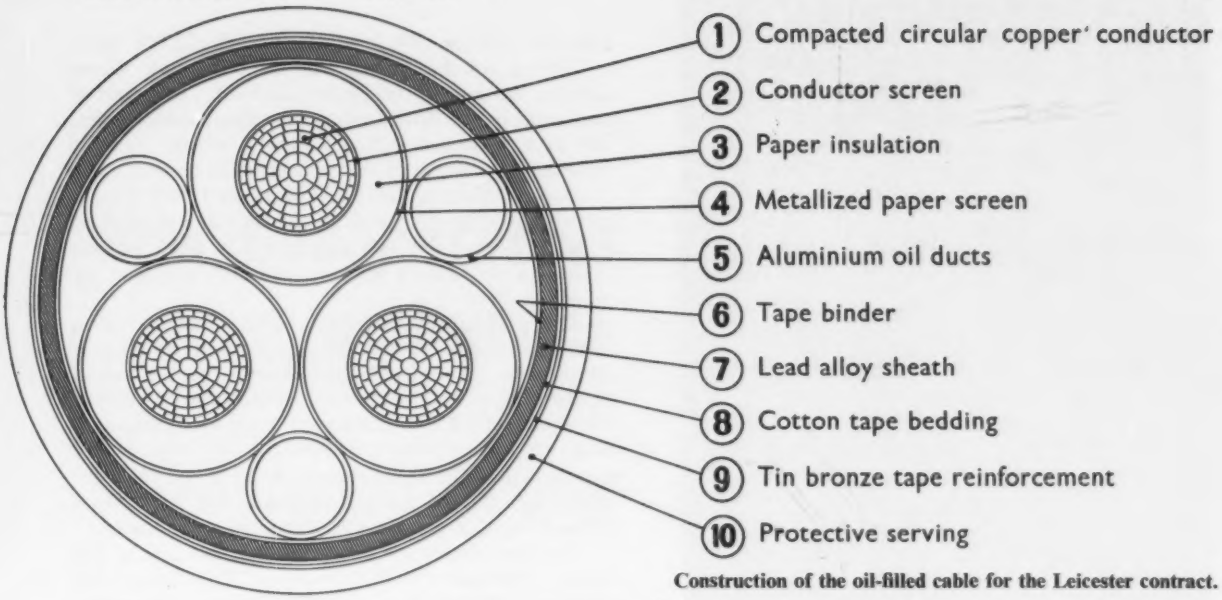
The laying-up machine at work on the big Leicester cable.

Top illustration shows a joint bay. The valve screw in the gland flange on the side of the joint is being replaced after the sweating of the ferrules. *Below*, the cable being pulled out—its size is evident.

depot at Melton Mowbray, which became the centre of operations for the installation planning.

Almost at once a minor crisis arose which was averted by smart work on the part of the cable gangs—a crisis which was caused by a football match! A short distance from the power station, on the first section of the route, the excavations for the cable trench bisected the car park of the Leicester City F.C. who, in February, were playing off their fourth round F.A. Cup Tie at home against West Bromwich Albion. By anxious request, installation was speeded up so that the car park could be left unobstructed for the Cup-match fans and by special efforts in a race against time, the last shovelful of backfill was packed into the trench just before the main crowds started to arrive after noon on Cup-match day.

The main Leicester thoroughfare which the cables followed for the first part of the route passes over two bridges, situated within a short distance of each other, crossing the river Soar and a viaduct where accommodation under the sidewalk was very limited. Besides being of shallow depth (eleven inches maximum), the available space was nearly filled with cables of various sizes and services, laid in years past. When the paving was opened up, the existing cables had to be carefully laid aside in order to make room for the feeder and pilots. To isolate and protect the new cables, brick chases, three bricks deep, were constructed over the bridges and the 132kV cables were bedded in a layer of sand in these. On a further covering of sand inside the chases the pilots



Construction of the oil-filled cable for the Leicester contract.

were laid and the chases were then sand-filled to the top. Finally, just beneath paving level, half-inch-thick flat steel plates were placed to cover the chases as a protection from mechanical damage. Once past the bridges the only obstacles along the route were a railway yard, where the cables were drawn into ducts under the tracks, and three road intersections. At the intersections, headings were driven for cable tunnels to avoid dislocation of heavy traffic. One of these headings, which passed under a traffic roundabout, required an excavation some 14ft deep. Earthenware pipes were laid in the tunnels, the excavations being afterwards filled in with concrete. The last 300yd of the cable-laying called for trenches along the centre-strip of a main dual-carriageway road, to where the cables were terminated in solid stop-joints at the site of the new Blackbird Avenue substation.

The task of jointing the large oil-filled supertension cables was given to the most skilful of the specially trained A.E.I. Construction Division jointers. Jointing must continue non-stop once work has started at any particular joint bay, and there is more than a full twenty-four hours' work in a straight-through 3-core joint for this type of cable. Some thirty joints were made to the oil-filled cables during the course of the Leicester contract, and sealing ends were also supplied, erected, and jointed by A.E.I.

William Thomas Henley's Name Perpetuated

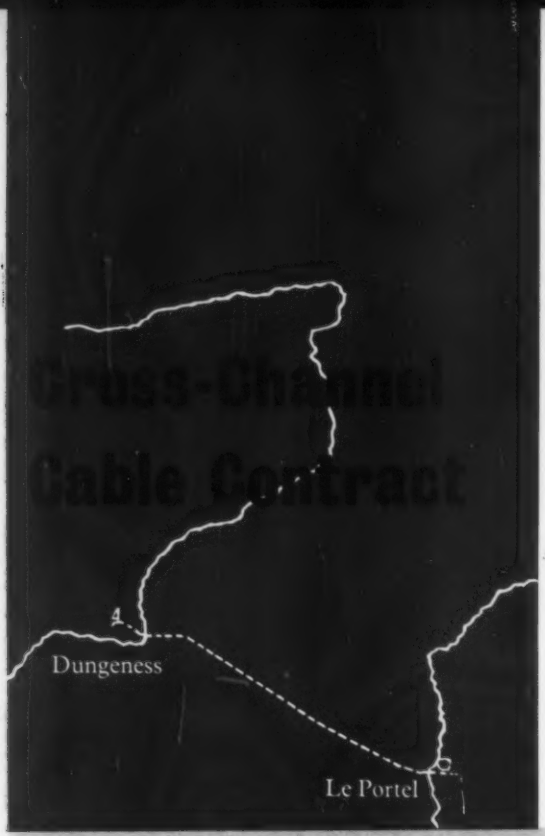
Gravesend Technical College Institute New Prize Fund

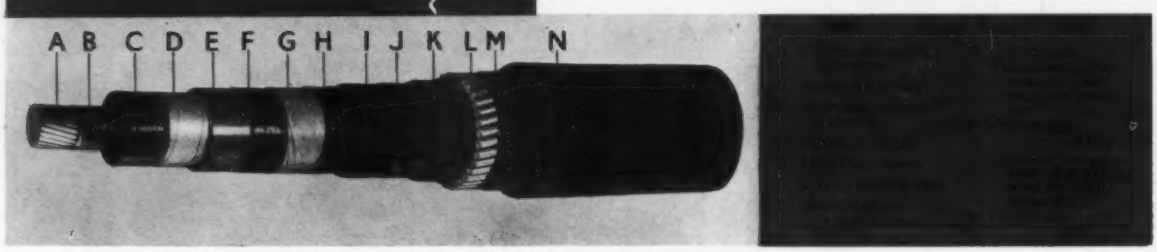
THE LONG ASSOCIATION in the past between W. T. Henley's Telegraph Works Co. (now part of A.E.I. (Woolwich) Ltd) and Gravesend Technical College has been commemorated by the governing body of the college by the institution of a prize fund which is to be known as the "William Thomas Henley Prize Fund". Under the provision of the fund two prizes will be awarded annually by the Principal to students undertaking part-time courses of study at the college.

William Thomas Henley, founder of W. T. Henley's Telegraph Works Company, was a man who rose to success without any of the educational advantages of the present-day apprentice. When he travelled to London to seek his fortune at the age of sixteen he knew only the craft of his grandfather's business—that of a fellmonger. But while working as a porter and dock labourer he studied mathematics and scientific subjects in his lodgings and acquired the knowledge which enabled him to found, and prosper in, his own business. He first set up a small workshop in which, aided by his inventiveness, he began making covered wires and scientific instruments which attracted the patronage of men like Daniell and Wheatstone. From this small beginning he progressed to building a large factory by the Thames riverside at Woolwich, thus founding a prosperous business which came to be concentrated on the making of electric cables.

Thus the educationalists of today honour a man who showed that the way to success was that of determined application to study. That his name is given to a prize fund for part-time students is particularly apt.

Cross-Channel Cable Contract





THE CENTRAL ELECTRICITY GENERATING BOARD has announced that the British half of the 32-mile-long 200kV d.c. cross-Channel power link will be manufactured jointly by the A.E.I. Cable Division and British Insulated Callenders Cables Ltd. This historic power link with France will be laid in 1961. Two single-core cables will be used which will enable 160MW of power to be exchanged.

The one difficulty with d.c. is the deflection it could cause in the compasses of ships passing through the Channel. This snag is to be overcome by laying the "go" and "return" cables close to each other—a tricky job at the depths involved, but it has been established during actual sea trials that it can be done.

The 200kV d.c. circuit will be laid underground for 4½ miles between Lydd converter station and a link-house at Dungeness. Its counterpart on the French side will be situated in the suburbs of Boulogne. From Dungeness the submarine cables will be laid to the mid-point of the Channel, where they will be jointed to the French sections. The latter will be laid to the French coast at Le Portel, near Boulogne, and so underground to the converter station to join the French 225kV grid.

Laying will be carried out from the m.v. *Dame Caroline Haslett*, owned by the C.E.G.B. The length of each cable on the British side will be about sixteen miles, laid at a maximum depth of twenty fathoms. On the French side a depth of thirty fathoms is reached.

Each single-core cable will work at 100kV d.c. to earth—one at positive polarity and the other at negative polarity. Normal full-load current will be 800A, but the cables will be capable of carrying a 20% overload for thirty minutes.

The submarine cables are 3·07in. diameter, with 0·525sq.in. copper conductors, lapped with an electrostatic screen, paper-insulated solid type with a second electrostatic screen, lead alloy sheathed, protected with v.r. tapes and 0·232in. galvanized single wire armoured. Anti-twist tapes are also incorporated in the construction to enable the cables to withstand possible stresses if recovery is necessary for repairs. Weight of the cable is about 37lb/yd in air and about 28lb/yd in sea water.

The land cables use a larger conductor size of 0·6 sq.in.—a measure necessary because of the inferior heat-dissipation properties of the soil compared with conditions on the sea-bed. In the shingle areas, where this problem is still further aggravated, a conductor size of 0·925sq.in. will be used. The land cable will be of similar design to the submarine cable except that neither anti-twist tapes nor the anti-corrosion protection will be used, and the armour wires will be considerably smaller.

As to the advantages to be gained from this power link, they rest chiefly on the difference between French national time and Greenwich Mean Time—the former being one hour in advance of GMT. In mid-winter, peak demand in France occurs at 8.30a.m. against 5p.m. in Britain. Seasonal differences are also important: France's hydro-electric stations need not spill water if the surplus cheap power can be exported to Britain at peak times, thus reducing the use of the more expensive coal-fired stations in this country. At times of water shortage Britain's thermal plant could export power to France.

The entire cost of the d.c. link is estimated at £4·6 million, and the annual net saving to this country should be about £¼ million. Against the cost of the scheme must be set the cost of future plant which would have to be installed in Britain if the d.c. link were not available to meet peak demands—a sum in the region of £8 M.

New Laboratories at Harlow for Woolwich Group

IN MAY, Lord Chandos, Chairman of Associated Electrical Industries, pressed the button of a tiny transistorized radio transmitter and unveiled by remote control a plaque at the main entrance to the new A.E.I. Research Laboratory at Harlow in Essex.

Present at the ceremony were guests from many British engineering, electrical, and electronic concerns and Government scientific departments, as well as representatives of the A.E.I. Manchester and Rugby Groups.

The laboratories will serve the A.E.I. Companies and Product Divisions of Associated Electrical Industries (Woolwich) Ltd. It was typical of A.E.I. that the housing of the tiny transmitter operated by Lord Chandos was designed and machined in the very Harlow Model Shop which is part of the laboratories, and that the transmitter itself had been built by the Electronics Department. The signal was picked up by a radio receiver and used to operate a relay, releasing a curtain which veiled the plaque.

The ceremony marked the culmination of two years' effort at Harlow, during which the laboratory has been built and staffed virtually "from scratch". This achievement has been made more remarkable by the success already gained in the research projects in hand.

There are nine main sections of the laboratory, served by the Model Shops and Glass Shops for the making of specialized equipment. The nine sections are concerned with investigations into phosphors and photoconductors, transistors, magnetic materials, vacuum physics, image tubes and electron optics, metallurgy, chemistry and materials, and telecommunications. The latter section, although administratively part of Harlow, is housed in a separate laboratory at Blackheath in south-east London, where its proximity to Woolwich enables close liaison to be maintained with the factories.

The investigations carried out by any of these sections may have a bearing, direct or indirect, on the manufacture of cables and electrical equipment, whether concerned with the improvement of the materials used or the control of manufacturing processes. Obvious applications are the detailed investigations into the metallurgy of lead alloys being carried out by the metallurgy section and the inquiries into improved dielectric materials by the chemistry and materials section.

To aid its research, the metallurgy section possesses X-ray diffraction equipment; heat treatment equipment, including a laboratory arc-furnace in which metals, and some non-conductive materials, can be melted or treated up to temperatures in excess of 4 000 C.; mechanical equipment for tensile testing and the determination of hardness and ductility; and specially designed small-scale equipment for converting material to strip, foil, rod, wire, or other forms suitable for incorporation into experimental devices for performance assessment.

Alumina, when added to polyethylene, improves the latter's thermal conductivity threefold, and gives added current-carrying capacity to a high-voltage cable insulated with this material. Polypropylene has advantages over its nearest relative polyethylene as a dielectric, having a higher melting point and good electrical properties, but certain disadvantages at high and low temperatures are being investigated by the chemistry and materials section.

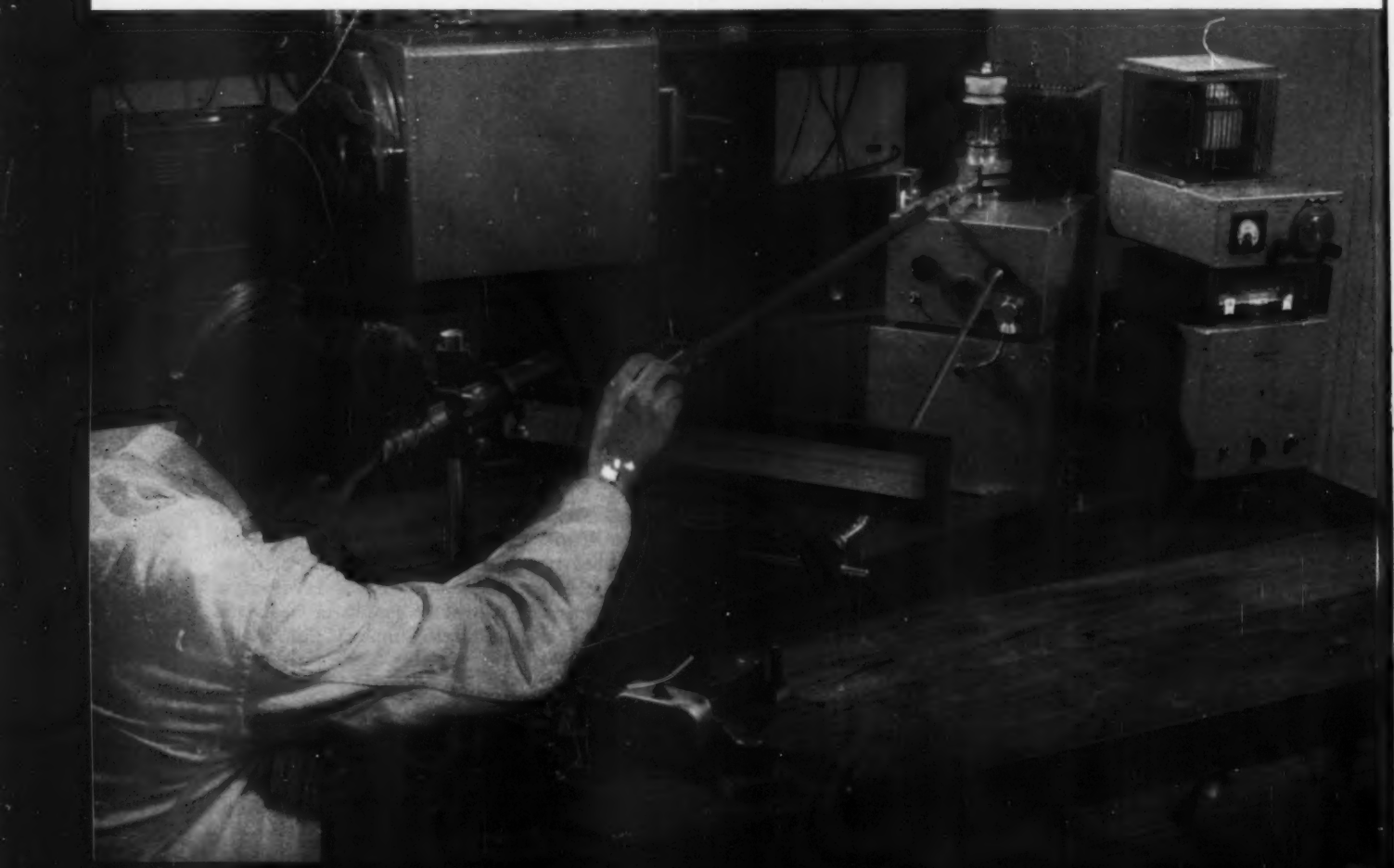
There are two telecommunications sections. Telecommunications I is chiefly concerned with electronic switching for electronic telephone exchanges, with time multiplex systems, and with some aspects of frequency division multiplex systems. Telecommunications II interests itself mainly in investigating frequency division

multiplex systems (including relevant system, cable, unit, and component application studies), in the use of digital and analogue computers for circuit analysis and design problems, and in related mathematical studies.

Apart from research undertaken specifically for the Product Divisions and A.E.I. companies in the Woolwich group, the laboratory has other achievements of which it can boast. Notable among them are the electron image intensifier tube developed for use with the electron microscope; an optical image intensifier developed to record weak luminous phenomena such as distant stars; the production of cadmium sulphide photo-cells which respond to visible and higher energy radiations and which have applications as radiation monitors both in the medical world and in the field of atomic energy; and production of the solid electrolyte tantalum capacitor, a component which has a very high capacity-to-volume ratio, operates over a wide temperature range, and is devoid of the corrosive fluids found in conventional electrolytic capacitors.

A bank of resistance furnaces and control equipment necessary for very close temperature control in heat treatment of experimental alloys.

The dielectric constant and power factor of sheet samples of plastics material are evaluated on a Hartshorn Ward dielectric test set.



Lord Chandos giving the presidential address.

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BOURNEMOUTH

RUMOUR HAS IT that the tame weather boffin retained by the B.E.P.C. organizers has been offered huge sums to desert to the Meteorological Office. Be that as it may, the twelfth British Electrical Power Convention was greeted with the customary brilliant skies and a sparkling sea on Monday, 30 May 1960, at Bournemouth.

The Convention was officially opened by the Mayor of Bournemouth, Mrs Bicknell, when she extended a civic welcome to the delegates, in the Pavilion on Monday afternoon. It was then the duty of the president of the Convention to deliver his address.

When Lord Chandos arose, delegates anticipated an interesting half-hour. Nor were they disappointed. In an address both agreeably pungent and pithy, Lord Chandos expressed forthright opinions and, driving home his points with facts interspersed with dry, relevant humour, gained respect for them.

He reviewed briefly the rising standard of life in the last ten years and the role of industry in "doubling the standard of life by 1985"—a process which meant doubling the demand for electricity or its equivalent. The Central Electricity Generating Board was praised for its refusal to be put off from developing future new sources of power, and Lord Chandos mentioned the problems of the manufacturers faced with the making of fewer and larger generating sets and turning to export outlets for succour.

On the problem of selling overseas to countries needing credit the president instanced the financing of schemes which were often awarded by the debtor to the country able to supply plant below the cost of the same plant to the outside world. "If we are not to ruin our industry," he declared, "we must have more common sense and more co-operation amongst ourselves." The mere lending of money to underdeveloped countries was not necessarily the way in which their development was best fostered. Actual projects directed towards the banishment of starvation-level existence took priority.

Anticipating the future, Lord Chandos pin-pointed the musings of a historian looking back on our age, astonished at our ingenuity in making wonderful pieces of mechanism, but no less astonished at our lack of thought in devising how best they might be used. The historian, he said, will puzzle his head over why, in 1960,

it was quicker to walk from the Mansion House Underground Station to the Bank of England than to ride in a machine capable of 120 miles per hour, and why the telephone is so often used to support a cantilever system of responsibility so that "by telephoning, everyone leans on everybody else until the boss happens to go to the races and then the whole structure collapses because he cannot be reached in the paddock!"

Lord Chandos was equally forthright on the wasteful use of highly qualified and paid talent where several teams worked on expensive research in competition to attain one objective. The aim should be to rationalize research, even if it did mean "that this is going to lead to some very uncomfortable luncheon parties at which competitors will wait to see whether their host drinks the wine before they start drinking it themselves!"

▲

The inner lounge of the East Beach Café transformed by A.E.I. to "Rosherville Gardens" for the pleasure of Convention delegates.

Illustrations below show Dr and Mrs J. N. Aldington greeting Lord Chandos (*top left*) and Mr R. P. Watson (*below*).

On the right Mrs D. Howarth and Mr and Mrs M. R. Wagner revive an old custom by throwing coins into the fountain at "Rosherville Gardens". The E.I.B.A. benefited to the tune of £3 3s. 6d. from this novel form of collection.

Lord Chandos concluded: "The theme of this Convention is 'Electricity—the New Horizon'. We must wake up every morning and think of the future. I admit to being of a sanguine temperament, but I can think of no industry which offers greater opportunities to young men, or which makes a greater contribution to man's control over material than the industry which is represented here today."

No Exhibition—but delegates were invited to "Rosherville Gardens"

Although there was no trade exhibition at Bournemouth for the 1960 Convention, A.E.I.'s Cable, Construction (Cables and Lines), and Radio and Electronic Components Divisions of the Woolwich group took over the large East Beach Café and transformed it into an elegant morning, afternoon, and evening rendezvous for delegates. The décor, specially devised for the occasion, was based on the Victorian pleasure resort of Rosherville Gardens, which once covered the site of the present Gravesend Distribution and Equipment Works of A.E.I., by the side of the cable factory.

The transformation of the café into "Rosherville Gardens" was accomplished by draping the walls of the outer lounge in white, lining them with black pergola poles, true replicas of the period, and installing a scarlet and black ceiling.

The inner lounge presented a colourful garden scene under a night sky of miniature electric bulbs. On one side of this lounge, in gay Victorian grottoes, were 8ft × 4ft enlargements of original engravings of illustrations of Rosherville Gardens, showing the archery lawns and various aspects of the pleasure gardens. Opposite these scenes were enlarged cutouts of children's fashions of the period. These, tinted in gay colours, proved of great interest to the many ladies who attended the reception centre.

The focal point of the whole scheme was an elaborate rock garden, dominated by a reproduction of a graceful stone belvedere which was part of Rosherville Gardens. It was flanked by a waterfall splashing merrily over the rocks into an upper and lower pool. This fountain was turned into an impromptu wishing-well by visitors (see photo) and the E.I.B.A. received a small surprise donation as a result.

The illustrations in the right-hand column show (*top to bottom*):

Mr Venner, Mr T. W. Walsh, Miss Boobon, Miss D. Cattle, Mrs Rich, Mr F. R. Edwards, Mrs Walsh, Mr J. K. Webb, Mr W. T. Rich.

(*Seated*) **Mrs Luke, Mrs Squire, Miss Peck, Mrs Sheppard (President of the E.A.W., Bournemouth), Mr G. H Mann, Mr N. H. Sheppard (E.C.A. Chairman, Bournemouth).** (*Standing*) **Mr J. E. Peck, Mr E. M. Luke, Mr G. H. Squire.**

Mr and Mrs D. G. J. Millington, Mr H. F. Brewer, Dr Wesson, Mrs Ferrer and Mr J. P. Ferrer.

Mr R. M. Broadfoot, Mr H. Millyard, Mrs Thomas, Mrs Millyard, Mrs Broadfoot, Mr R. D. Thomas.

Mr F. Bannister, Mr E. W. Semmens, Mr D. S. Howarth, Mrs Bannister, Mrs Howarth, Mrs Semmens.

Other Events

The four papers which were presented to the Convention delegates are briefly summarized the in following pages. Other events were the Electrical Forum, well attended and well served by a lively panel who comprised Mr N. Elliott, chairman of the S.E.E.B.; Mr S. F. Steward, director of B.E.A.M.A.; Miss Mary George, director of the E.A.W.; and Mr A. R. Cooper, member of the C.E.G.B., with Lord Chandos as question master.

The luncheon given by the Electrical Association for Women was addressed by Mrs H. S. Davidson, and Lord Chandos replied in complimentary vein. Viscountess Kilmuir, E.A.W. president, bade the guests welcome, and the Lady Mayoress graciously answered the toast.

At the annual Convention dinner the guest of honour, the Marquess of Salisbury, K.G., P.C., F.R.S., gave a lively description of the first electrical lighting installation at Hatfield House and his grandfather's reactions to it. Lord Chandos, responding, recalled the longstanding friendship between the Marquess and himself.

Mr C. R. King, chairman of the Electricity Council, carried the toast of "Our Guests and Ladies". Sir Alan Hitchman, K.C.B., of the Atomic Energy Authority, included in his reply a warning on the future costs of electricity produced by atomic power.

At the annual general meeting which concluded the Convention, Sir John Pickles was elected president for 1960–1 and Mr W. H. McFadzean was elected vice-president. A final vote of thanks was proposed by Sir John Hacking to Viscount Chandos for his brilliant chairmanship of the proceedings.

Viscountess Kilmuir speaking at the E.A.W. luncheon with (*left to right*) the Mayor of Bournemouth, Lord Chandos, and Miss Mary George.

Illustrations on the right (top to bottom):

The Mayoress and the Mayor of Bournemouth, Lord Chandos, and the Marchioness and Marquess of Salisbury awaiting guests at the Annual Dinner.

Lord Chandos speaking at the Annual Dinner. Principal guest was the Marquess of Salisbury (*left*). On the right are the Mayor and Mayoress of Bournemouth.

Lord Citrine and Sir Willis Jackson with Mr and Mrs C. R. King.

Mrs and Mr G. Conradi, Mr K. S. Estlin, and Mr D. B. Beavan.

Abstracts from the Convention Papers

No. 1. The New Horizon—Electrical Manufacture

By the Hon. H. G. NELSON, M.Inst.C.E., M.I.Mech.E., M.I.E.E.

The Hon. H. G. Nelson delivering his paper.

WE KNOW FROM experience that the growth of the economy to which our own activities relate is not steady, but in trying to forecast trends and plan our business activities we must distinguish between short-term and long-term trends and not be diverted from our main purpose by the inevitable but short-lived interruptions to expansion.

Electricity in the Home

During the decade 1948–58, whereas consumer expenditure generally increased by about 22%, the purchases of electric domestic appliances rose by 120%. Although we have some way to go before we catch up with the Americans, it seems likely that the level of saturation for telephones, washing machines, refrigerators, and television sets will reach the American level of 95–100% by about 1975.

The effect of these rapid growths in demand on manufacturing industry is that an increasing amount of our business is in the mass-production field. The capital investment represented by such mass-production lines is very large and hence the need for accurate forecasting.

One of the most difficult questions to be answered is whether any particular activity is more likely to be undertaken at home or away from home. Laundry and entertainment are tending to take place in the home. Similar questions have to be asked in relation to other household tasks.

From surveys it is clear that electric heating is favoured for secondary uses but is hardly used at all for the main source of space heating. Undoubtedly, the great potential market to be exploited in the next ten years is that for central heating.

Electricity in Industry

The most valuable contribution which process electricity may be expected to make in the next few years is to facilitate the introduction of new materials, especially metals, and to reduce costs. The real cost of electricity to consumers has declined over the years and it follows that all those products, such as aluminium and copper, in whose production large quantities of electricity are involved, will also decline in cost.

Not only manufacturing, but rail traction, the lifeblood of British industry, is being revolutionized by electrification. No new steam locomotives have been ordered for several years and already British Railways have in service 350 main-line diesel electric locomotives and 900 diesel electric shunting locomotives. Within the next three or four years the total of all types will have risen to 3 000.

Electric power has also been applied increasingly to agriculture and has contributed to the rapidly rising trend of productivity which has been seen in this industry over the past twenty years. There is as tremendous a scope for increase in farming as in manufacturing industry.

Control

The greatest innovation now unfolding is the linking of electronic data processing to control. The application of computers to manufacturing control, sometimes called automation, is in my view going to extend to many more industries in the next decade or two.

It is important to bear in mind that electronic data processing and computing equipment is expensive to install and expensive in its use of highly qualified staff for programming and other work. This could well mean that its greatest impact would be in large units and this would almost certainly hasten specialization and rationalization in many industries.

Generation and Distribution

What are the limitations on size which might prevent the present trend to larger generating units continuing?

With regard to generators, at the moment we cannot see our way to design a single rotating machine larger than 550–600MW. Two of the principal considerations from the manufacturer's point of view are the size of the load we are allowed to transport by road and the strength of end bells.

The use of new and exotic metals, many of them pioneered in the aircraft and atomic energy industries, may enable further advances to be made in the future. Titanium has physical properties which could, in theory, enable one to employ larger rotor diameters and if a suitable titanium alloy were available at the present time, a machine could be so designed with a capacity of about 800MW.

The increase in size of set has contributed materially to the reduction in cost, but this process cannot be expected to continue indefinitely. The increase of efficiency with size and the economies to be achieved will become more and more marginal. Taking all factors into account and assuming advances

in techniques but no revolutionary discoveries, the possibility may be envisaged of cross-compound double-shaft sets of 2 000MW coming into operation during the 1970s.

There are other possibilities in the more distant future, particularly the eventual replacement of fluid cycle heat engines, especially steam turbines, by the direct generation of electricity either from hydrogen fusion, fuel cells, or some thermo-electric technique.

In the United Kingdom we already have the world's largest interconnected grid system operating at 132kV and within the last few years the supergrid, operating at 275kV, has been introduced for the bulk transmission of power. Higher a.c. voltages are desirable in many cases in the United Kingdom, particularly to make the best use of existing wayleaves. 500kV seems a logical next step although 750kV or more may be necessary in many overseas cases. This faces the manufacturing industry with the need to develop the necessary equipment.

Conventional circuit-breaker equipment still has considerable development potential and the above voltages with very high short-circuit ratings should be well within our capability. Vacuum switching and semi-conductor techniques may provide scope for further developments in the next ten years, but at present there are severe capacity limitations and some major break-through is required before they can be applied to these very high ratings.

Transformers, like generators, are limited in size by road transport considerations and the largest three-phase transformers which have been built are rated at 345MVA. 500MVA is probably the highest rating that can be achieved within the present size limitation, although there is no fundamental reason why 3-phase transformers of 1 000 or even 2 000MVA could not be built if needed.

The Electrical Manufacturing Industry

Most of the trends indicated (i.e. the move to larger products, the increase of mechanization and computerization, and the growing technical complexity of our products) impose on the manufacturer a very heavy outlay in capital expenditure and a high ratio of overheads to direct expenditure.

A recent D.S.I.R. inquiry showed that, whereas British manufacturing industry generally spent 2·6% of their turnover on research and development, in the electrical industry the ratio was 9·8%.

It is important to realize that this massive technical effort represents a very considerable amount of solid regular work rather than a succession of brilliant discoveries.

It has to be borne in mind that even when we are presented with a new material and we establish its mechanical and electrical properties by appropriate methods, we cannot be sure how a machine embodying such a material will behave and very large, costly installations are often necessary, purely on an experimental basis.

For many years large electrical companies have operated manufacturing subsidiaries—particularly in the older Commonwealth countries such as Canada, Australia, and South Africa.

The opening of local plants is a means both of maintaining exports from this country and of maintaining the necessary sales force to make this possible. In almost every case, within a few years the local factory is taking over more and more lines of manufacturing and in so doing is stopping the export of these particular lines from the British factories. But all experience shows that, in the long run, industrialization breeds a demand for imports of industrial products.

In recent years we have sometimes been forced to develop alternative, more economic, designs for equipment destined for overseas. This tendency will increase and, in the years to come, there will be a greater tendency for a world-wide network of factories to be operated as a system and for work to be allocated according to complex problems of politics, economies, and expediency.

No. 2. The New Horizon—Electricity Supply

By C. R. KING, C.B.E., Comp.I.E.E., M.Inst.F.

Mr C. R. King speaking on "electricity supply".

Growth of Electricity Demand

In 1959 the Generating Board made a careful analysis of records over the past decade and found that the winter peak demands experienced on their system over that period, when corrected to standard weather conditions ("average cold spell"), corresponded closely to an average growth rate of 6·9% per annum.

A similar analysis of annual unit consumption showed that the average growth rate was about 7·8% per annum.

Taking the view, however, that any future departure from this trend might be downward rather than upward, the Board put forward for adoption by the Electricity Council, for planning purposes up to 1967–8, a series of estimates corresponding to a growth rate of peak demand of 6·5% per annum and of unit consumption of 7·5% per annum.

Generation

The pattern of new generating stations planned for commissioning in England and Wales during 1959 to 1964 reflects the development of the large generating unit and the expansion of generating station capacities to the 1 500MW envisaged for the coal-fired Drakelow "C" station. Stations as large as 2 000MW may appear in later programmes; two sites have recently been found in Nottinghamshire where coal-fired stations of this size could be accommodated.

The year 1959 saw the commissioning of the first 200MW generating unit, at the High Marnham station. Within four years this will yield pride of place to the 275MW sets at Blyth "B", the 300MW sets at West Thurrock, and the cross-

compound units of 550MW, each virtually equivalent to two 275MW units, at Thorpe Marsh. The 350MW sets which are scheduled for installation at the Drakelow "C" and Blyth "B" stations are distinguished by being the largest single-shaft units yet designed in this country.

A feature of the year 1961 is the commissioning of two hydro-stations, namely at Rheidol, which will provide 49MW of orthodox hydro-plant, and at Ffestiniog, which is to be the first large pumped-storage plant in this country, with a capacity of 300MW. In that year, too, the first two nuclear stations, at Berkeley and Bradwell, are expected to begin operation.

The average thermal efficiency of conventional plant during 1964–5 is expected to reach a figure of about 29·6% as compared with the 26·1% of last year. The still larger sets due to come in before the end of 1964, namely the 275MW units at Blyth "B" and 550MW units at Thorpe Marsh, are expected to attain figures of about 36% and 36·5% respectively.

Automization of generating plant operation is now almost a theoretical possibility. The Generating Board's approach is first to achieve fully remote control, actually at West Thurrock; and then, if this is successful, to employ a computer to control the operation.

Nuclear Power

For the years up to and including 1964, five nuclear stations will be commissioned in England and Wales. When completed they will have a total capacity of 2 075MW sent out and provide some 10% of the Generating Board's total electricity output. The Minister of Power has recently sanctioned the construction of a sixth nuclear station at Sizewell, Suffolk, of a capacity of 550MW sent out.

A seventh nuclear station is proposed at Oldbury-on-Severn, with a total capacity of 550MW. If its construction is authorized it seems likely that it will figure in the 1965 and 1966 programmes.

Allowing for an eighth nuclear station in 1966, the total nuclear capacity in England and Wales by the end of that year would be some 4 623MW sent out, this including the output of 148MW from the United Kingdom Atomic Energy Authority's plant at Calder Hall. The total nuclear capacity for Great Britain would be about 5 100MW sent out.

If current development work on the Advanced Gas-cooled Reactor (A.G.R.) proceeds satisfactorily, it might well be that a reactor of this type would be installed on the system, perhaps in the late 1960s.

Looking further ahead, it is thought that by the early 1970s a commercial fast breeder reactor might be in commission with even lower capital and running costs than the A.G.R. The fast reactor would make use of the plutonium by-products of the earlier types of reactors.

It would seem that the only practicable large-scale method of energy storage today is by pumped-storage hydro-plant. According to an estimate made a few years ago, the total pumped-storage potential in England and Wales and Southern Scotland is not more than 2 000MW, and there is always the possibility that some of the sites would be sterilized as conflicting with amenity interests.

A longer-term prospect would be chemical energy storage, for example through the fuel cell, for where small amounts of local power are required, as in some forms of traction. Its efficiency is of the order of 60% to 70%. Off-peak power from the generating stations could be applied to the electrolysis of water to produce the hydrogen and oxygen for these cells.

Two direct methods of generation which have already shown promise are thermo-electric generators (of relatively small capacity) and thermionic generators.

A further possibility is storage by compressed air, whereby air would be compressed by motor-driven compressors and delivered to steel pressure vessels or even possibly to underground caverns for storage.

There is a great potential for the battery-driven road vehicle, which could absorb a significant quantity of off-peak units from the power stations, and during the past ten years the number of these vehicles on our roads has already increased by about 60%.

Basic studies and preliminary experiments are also proceeding on another method, whereby electricity is generated directly from a hot gas by taking advantage of its ability to conduct electricity. This is the Magnetohydrodynamic (M.H.D.) concept, which could render conventional boiler plant and turbo-alternators unnecessary.

Transmission

The primary object of the 275kV supergrid is to provide adequate interconnection capacity between the various areas, but a secondary object is to permit the bulk transmission of electrical energy from the cheap-coal areas to the principal load centres of the country. It is envisaged that the development of bulk transmission will call for operation at a higher voltage, of some 380kV, and parts of the transmission system have been designed for operation at such a voltage. We may, in the future, have to raise our main transmission to 500kV.

At the end of 1963, the 275kV supergrid will comprise 1 912 route miles of transmission lines. Next year the cross-Channel submarine cable is expected to be commissioned, to interconnect the supergrid with the 225kV system of Électricité de France. The transmission capacity is 160MW in each direction and operation will be at 200kV d.c. This interconnection will achieve savings in capital and on revenue account.

Distribution Systems

With the load increasing at some 7% per annum, the Area Boards must face the problem of doubling the total capacity of their substations every ten years or so, including the provision of a large proportion of new substations. To supply large numbers of small consumers in built-up areas, it may be necessary to resort to buried transformers on a considerable scale, while packaged switchgear may be essential to réduce the physical size of 33kV substations.

In the more distant picture we may, in order to meet the demand for more compact substations with lower levels of noise and lower losses to be dissipated, have to turn to the electronic field where a start has been made on the production of miniature transformers and circuit-breakers using semiconductor techniques.

Commercial Aspects

It seems quite certain that the pace of new developments will be even faster than previously experienced.

What are the main factors to be considered in arriving at estimates of future demands, energy sales, and system load factors? The population, as we know, is still increasing, but at a slower rate. Although new domestic premises will continue to be built, a large proportion of these may represent rehousing of existing city and urban consumers. The task of connecting additional premises, and the addition of new load,

for that reason alone, will soon begin to taper off for, with the completion of the present rural development programme by 1963, some 85% of farms, over 90% of other rural premises, and some 95% of all families in the land will have been afforded an electricity supply.

Future electricity requirements will in the main be shaped by the needs of industry and the rising standards of living likely to be achieved by the population as a whole.

The electrification of rail transport and the better lighting of highways are improvements in public services which have already made some progress, but a good deal remains to be done.

It may be concluded therefore that forecasts of future demands and energy requirements are not only justified by past results and past trends but also by sober consideration of the uses to which expanded electricity supplies will be devoted. From what has been said earlier in this paper, the trends of costs, and consequently of prices, are in the right direction at the present time.

No. 3. The New Horizon—Electrical Export

By E. V. SMALL

Mr E. V. Small addresses the Convention.

Export Targets

The export side of a business should be treated as an equal of the home side, entitled to develop on an agreed and stable policy, and not treated as a poor relation, to be petted or neglected in line with the trade climate in the home territory. Those responsible for obtaining export business can then take corresponding forward action in the reasonable certainty that when the time comes for decisions the full support of the factory organization will be forthcoming.

It might well be argued from reliable statistics that the economic basis of trading in the electrical machinery and apparatus section is clearly shown to be about 20% export, but is it the economic basis or is it the haphazard basis of finding its own level amongst all the hazards and handicaps which can be the lot of export trade? The industry must be based on a home market able to absorb the greater portion of the output available, but supporting and benefiting from a production which, with a high export content, can be very sizeably larger than one catering only for home requirements.

The overall shrinkage in the quantity market both at home and abroad must force us to pay more and more attention to the production of high precision goods, and to the sale abroad of designs and "know-how" resulting from our research and development investment.

I cannot believe that our industry can be satisfied with overall exports amounting to 20% of the national gross product for goods of this category. I suggest that an overall target of 25% as the export share of the total national product should not be an impossible target for the "New Horizon".

We cannot ignore what is steadily becoming, if it has not already become, a major factor in securing large capital contracts overseas. It is clear that more and more countries require more and more power and the demands are mostly in larger and larger individual projects involving finance over longer and longer periods.

While the various sources of loan facilities such as the World Bank and Fund, and the governmental or semi-governmental agencies operated by the creditor nations represent in total a very great contribution to the requirements of world finance, particularly in the underdeveloped areas, they leave a very wide field of credit demand which can only be satisfied by the utilization of private funds.

Great credit goes to the government Export Credit Guarantee Department for the assistance given to exporters, in spite of the shackles to which it is bound of rigidity of operation within terms of reference and powers of decision which can lag behind world conditions.

The bankers who have to find the money against the security of E.C.G.D. insurance cover will endeavour to do so by the use of funds of a type which match the period over which the credit is to operate and that period is controlled by the E.C.G.D. terms. With the present maximum period of cover obtainable, the type of funds available to the banks is in very great demand for a variety of other short-term purposes.

When highly technical equipment is involved, contracts must cover not just the supply of equipment but installation and commissioning with considerable local works included, and medium-term finance is required to enable a proportion of the project capital to be found from revenue.

If we are to meet the challenge of the '60s, Great Britain must find the means of utilizing money interested in fifteen to twenty years' investment. There should be a supply of funds for this purpose which the insurance companies have to place and, given reasonable security, such institutions would be ready to make considerable amounts available. Whilst it is true that such financing is dependent on the ability of the country to tie up funds in this way, we are in a far stronger position today with our overseas earnings and could well devote substantial sums to financial uses of this description.

I believe that the pattern in the future will be and should be for the banking syndicate to take the lead and to go abroad looking for worth-while financial operations to be negotiated because it is good business for the banks to do so. Present efforts directed to the capital goods exporter's requirements are not enough for the future.

Group Contracting

If finance is to be linked with a project and based on its merits and proper financing requirements, then contracting should take the same form. By so doing, the construction of the project can go forward as a unified operation.

It is on this basis that recent cases have occurred where contracts have been awarded to continental banking syndicates solely on the offer of finance to be used specifically on stated power projects, leaving the co-ordinated contracts to be negotiated at leisure within the global sums agreed.

I do not wish to give the impression that there is no group contracting done by our industry, but the day has passed when we can be satisfied only to chase, however energetically, the individual piece of apparatus.

A definition of group contracting is: *The formation of a group of complementary manufacturers and contractors through the medium of a company or a partnership for the purpose of tendering for and securing a contract for the execution of an engineering project overseas.*

The consulting engineers can and should welcome an extension to group contracting because group contracting on overseas capital projects can offer the consultant the prospect of collaboration with an industrial group in a manner wholly compatible with his professional status.

The small manufacturer or contractor can take part in similar operations, sometimes as a supplier of specialized equipment in a group of larger contractors or, with initiative, bring together his own group of manufacturers and contractors of similar status which could in many cases match successfully the efforts of the larger firms.

Communications

Very much to the forefront when considering the "New Horizon" is the increasing importance of what, for want of a better word, I describe as "communications" covering all types of contact, representation (including after-sales service), publicity, and public relations, which collectively sell the manufactured product from the factory in this country to the power station or factory overseas.

Among the organizations available to the electrical industry through which to foster communications I consider that BEAMA, the electrical industry's own association, stands out. The activity of the export side of BEAMA is not confined to this country, but extends overseas through the operation of committees set up in many parts of the world.

The modern pattern of overseas representation, companies' branches, resident representatives and engineers, and a constant traffic in specialists is by no means cheap to run. Export business will be seen to be gained only by efforts far greater than those required for home business and, on occasions, with less return.

Local Manufacture

Industry in this country, more so than in any other country, is faced with the dilemma of deciding whether it hurts less to help an erstwhile purchaser to take his business away from you and to do it himself, or to refuse to help and to see him find someone else, as must inevitably happen. It is not easy to be reconciled to the loss of business in markets where the demand has been built up and satisfied for so long by imported goods from this country.

Viewing the situation without sentiment then, the overseas operation should be able to pay its way and, right from the start, should make some return to the parent or associate in this country for services rendered.

The sources from which the proposals for local manufacture arise are (1) the local representation of the British manufacturer and (2) from local interests, Government downwards. Both may take several lines of action of which we may take the joint venture with a local concern on specific financial terms and with technical agreement as the only method common to both.

Where, as under (1), the British manufacturer takes the initiative, he should carry the whole responsibility for finance in the formative years, seeing that it is most unlikely that the local manufacturing operation will show a profit for some time. Then, and not until then, should it be considered reasonable to invite local participation in the finance required for an expanding business.

Where, as under (2), the initiative comes from the overseas territory, then undoubtedly the most satisfactory arrangement must be the outright sale of a manufacturing licence for a specific product.

Probably the most important point to bear in mind is that any British manufacturer of repute taking part in local manufacture on any other basis than a wholly owned subsidiary, must inevitably be considered as the dominant partner, regardless of the extent of his interest or authority, and must be prepared to be held responsible, rightly or wrongly, for the local operation with which he is associated.

This country must, at all costs, retain its leading position in research and development. We must be one jump ahead always of current design and practice and be ready and willing to sell our knowledge.

No. 4. The New Horizon—Electricity in the Home

By T. E. DANIEL, M.Eng., M.I.E.E., M.I.Mech.E.

Mr T. E. Daniel presenting his paper.

Envisaging the evolution of electrical equipment or the development of new appliances or installations is not just a question of what is technically possible but more one of exploring what form the pattern of living is likely to assume.

Probably the most practical approach is to study, one by one, the principal usages of electricity in the home.

Cooking

We have perhaps always regarded the electric cooker as being the key appliance on which we build our domestic load. Perhaps 250 000 domestic premises are changing over every

year to electric cooking. To achieve a greater share of the market and a very high proportion of electric homes, we need to be sure that appliance design keeps electrical apparatus, whilst including all necessary automatic devices, at an attractive price.

Water Heating

Disposals of electric immersion heaters in the last year or two give a clear indication that we are rapidly moving towards nearly 100% saturation in those premises where the plumbing arrangements permit a heater of this kind to be used.

It may be that the time is opportune for us to consider seriously that builders of new property should install hot-water vessels of not less than 50-gallons capacity, with sufficient accommodation for these to be properly heat-insulated, if not now, at a later date, so that the load can be taken at off-peak hours either by local time switches or by means of supervisory control. We may be wise in making our plans now for water heaters with loads of perhaps 5kW and to be considering the appropriate way of connecting these. The absence of any domestic plug and socket accepting a load in excess of 3kW may eventually prove a handicap and it is a matter of conjecture whether we ought not to be preparing our plans for the use of domestic 25-amp plugs and sockets.

Space Heating

Many householders are turning to the one refined fuel—electricity—which overcomes fuel problems without introducing other complications of safety, storage, etc.

We may be a little reluctant to encourage all-electric schemes for large local authority housing estates on new town or overspill sites because of the heavy capital investment on the distribution network, but is this not a short-sighted view? Should we not directly encourage the use of floor warming on such estates so as to have some measure of influence over the load characteristics?

We also need to be examining other ways of developing storage heating systems for existing property and in this connection the use of ceiling heating seems to offer possibilities.

Perhaps we shall see a central control panel whereby heating requirements for the day ahead can be programmed and from then onwards left to take care of itself.

Other Appliances

The average kitchen is quite incapable of accepting all the appliances which the housewife may find desirable. Many householders will inevitably have to resort to very small refrigerators which, whilst offering protection for the really essential products, do not give the storage space they really require.

The use of frozen foods will, without doubt, extend, whether these are purchased already frozen, or the householder's own produce frozen fresh instead of being bottled or turned into jam, as so often happens with fruit at present. Greater facilities for this will, therefore, be required either as part of the existing refrigerator or as a separate unit, but preferably the former.

The electric washing machine is now firmly established, but the controversy among housewives on drying facilities continues. However, it is surely not a very far step to suggest that properly designed drying cupboards ought to be part of new building plans.

Factors Influencing Trends

What are the principal factors in favour of or against the all-electric home?

While appliance sales have been quite successful, the public has not been so ready to welcome the increase in electricity bills resulting from the use of electricity to the exclusion of other forms of fuel. Necessary expenditure on maintenance and wiring is begrudged; heavy quarterly bills are not favoured against "pay as you go" fuel bills, and schemes for financing the increasing use of electricity from the householder's viewpoint are lacking in attractiveness.

The All-electric Home

In the past, as a rule housewives have been content with warming the rooms in constant use and tolerating the cold bathroom and the chilly bedroom. This is rapidly changing; the house (all-electric or otherwise) with comfort zones and arctic zones is no longer tolerable, and whole-house heating is coming in progressive stages. The whole trend in the electric home is away from inflexible single-source heating, cooking, or water-heating appliances.

The washing-up machine is slowly coming into its own and undoubtedly will become a high priority on the housewife's list of wants, as soon as the refrigerator has settled down in average-income houses. Other future possibilities are the electronic oven, the thermostatic probe for controlling roasting temperatures, accurately controlled boiling plates, electric waste incinerators, deep-freeze cabinets, and closed circuit television for the home.

The paper gives a *Schedule of electrical applications in the all-electric home of the late 1960's* in which the lighting, heating, cooking, and water-heating loads total 94·78kW. With the majority of heating at off-peak tariff (about two-thirds of the total consumption) and the remainder at on-peak domestic tariff, a calculation presents an overall cost of £113 9s. 0d. per annum for this 3-bedroomed house.

Billing and Collecting Methods

It is clear that as the all-electric house becomes increasingly common amongst consumers we shall have to collect from the average domestic consumer substantially larger sums than at the present time, amounting to £15 per quarter and upwards according to his standard of comfort and size of house to cover all his fuel requirements.

So far the quarterly account has been looked upon solely as a charge for electricity, but it is still further increased by hire-purchase payments, and to save the quarterly bill reaching unreasonable proportions there may be something to be said for monthly hire-purchase or credit sale, thus staggering the impact, besides offering terms comparable to those offered by private dealers.

Maintenance and Repair Service

With the all-electric house coming into its own, adequate voltage and security of supply assume still greater importance. Interruptions may be rare but consumers cannot be expected to rely on a single fuel source unless such interruptions are virtually eradicated.

It would probably be in the interests of the contractor and dealer and manufacturer for the Boards to provide, at rock-bottom price in the cause of electrical development, a basic inspection and adjustment service at a small quarterly charge as a way of discouraging the unqualified from doing repairs.

COOLKEERAGH

COOLKEERAGH POWER STATION is Northern Ireland's first oil-fired generating station. It has been sited in the north-west of the area served by the Electricity Board for Northern Ireland to meet the demands of future industrial development which is being encouraged in this area. It will also supply Londonderry city when the generating station there is closed down by the Londonderry Corporation Electricity Department.

At present two 30 000kW sets are in commission and one 60 000kW set will be installed for commissioning by the autumn of 1961. The 60MW turbine-generator, feed heater, and condenser are being manufactured by A.E.I. (Manchester) Ltd, at their Larne, Northern Ireland, works. The Transformer Division of the A.E.I. has also supplied two 37 500 kVA, 11 800/35 400V, 3-phase OFW cooled generator transformers and are manufacturing a 75 000 kVA, 3-phase generator transformer, with a ratio of 11 800/120 000V ON/OFB cooled, which will be fitted with an on-load tap-changer.

Two contracts, with a combined value of £125 000, for cabling at Coolkeeragh were awarded to Associated Electrical Industries by the E.B.N.I. Their Construction Division engineers commenced work at the power station last July and are now engaged in the final stages. Consulting engineers are Kennedy and Donkin.

The first of the two contracts concerns the power, control, and indication cabling for the two 30MW turbo-generator sets and accessories. The second contract is for the supply and installation of cables to the 110kV switching station (which serves the overhead lines extending the Electricity Board's 33kV and 110kV transmission system) and also for cabling to the nearby factories of Carbide Industries Ltd (a subsidiary of British Oxygen Engineering Ltd) and to the Du Pont organization's synthetic rubber plant at Maydown.

Cables installed for the power, control, and indication cabling comprised a total of approximately 18 800yd of 11kV, 3·3kV, and 1·1kV PILC cables, 37 000yd of 660V and 250V p.v.c. multicore cables, 4 000yd of p.v.c. telephone cables, and 23 400yd of 660V m.i.c.c. cables.

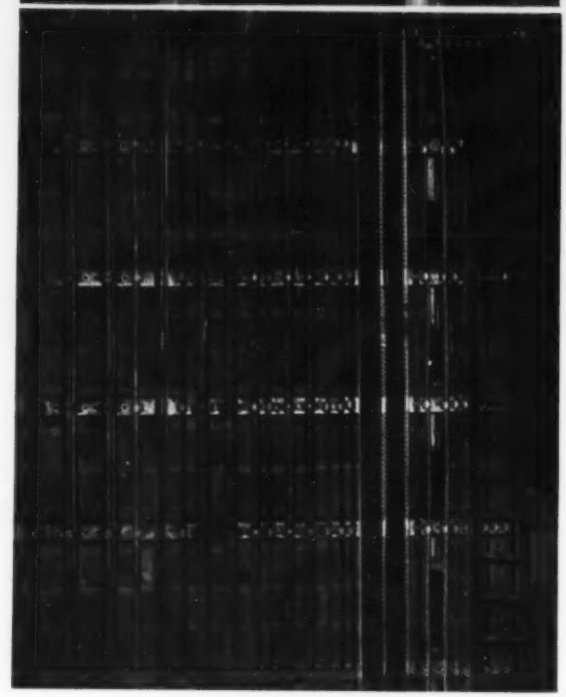
One of the first tasks on site was the erection of extensive steelwork for supporting the cable trays. Some thirty tons of galvanized steel and over 18 000ft of galvanized sheet steel perforated traywork were installed. Cables were laid in trenches to external power station plant, such as the cooling water pumphouse, the station transformers, the demineralization plant, the auxiliary boiler house, and the fuel oil transfer pumphouse. Cables to the control block to the south of the turbine house cover the last sixty to seventy yards to the block in a subway. In this cable tunnel they are supported on trays.

The second contract was rather more extensive in scope. Overhead transmission from Coolkeeragh is served by the 110kV switching station which is situated about sixty yards from the control block. The 33kV and lower voltage cables leave the control block by means of a covered cable bridge and enter a tunnel which leads to the switching station. Connections to the station transformers are routed in this manner and a direct 33kV cable link to the Coolkeeragh–Londonderry pole line is similarly installed.

The supporting steelwork used on this part of the cabling was all designed from the civil engineering plans and fabricated in England, then shipped to Londonderry for immediate erection. It amounted to 14½ tons of steel with an additional 16½ tons of traywork.

Top illustration shows l.t. cables installed on trays in the main cableway.

The illustration beneath shows a run of l.t. and 3·3kV cables from the control house annexe cable spread to the basement. Trefoil groups of 1·1kV cables are on the left and 3·3kV 3-core cables are in the centre. On the tray-work are incomplete circuits of 660V m.i.c.c. cables.



Supplies to the Carbide Industries plant and the Du Pont plant are carried by 33kV cables which lead off from the control block and, after entering the tunnel over the cable bridge, are routed to the west of the switching station to their respective objectives.

The nearest plant is the C.I.L. works, where acetylene gas is manufactured. Two 33kV feeders and pilot cables run for about a quarter of a mile to terminate at the works' 33kV/11kV transformers. These 33kV cables are 0·6sq. in. 3-core HSL type cables with a diameter of approximately 4·5in.

The Du Pont synthetic rubber plant (which incidentally is served with its acetylene gas requirements through a pipe from the C.I.L. works) lies over half a mile distant from the power station. Here again two 33kV feeders and pilot cables supply the power and terminate at 33kV/11kV transformers by the 11kV switch-house serving the plant.

Other cabling being carried out under the contract includes the switch-house cabling and that between the two generator transformers situated outside the turbine house and the control block.

Four 22kV sealing ends and one hundred and eighteen 33kV sealing ends have been supplied and jointed during the work at Coolkeeragh. Sealing end gantries, sealing end wall brackets, and supporting steelwork for pole-mounted sealing ends were naturally required for these terminations and were supplied under the contract. Numerous splitter boxes and joints, including bifurcating joints for the HSL type cable, were also supplied and installed.

Industrial development of this area calls for increased supply facilities to serve the new manufacturing plant. For example a new jetty has been constructed at Lough Foyle for ships transporting material and products to and from the Carbide Industries works. A.E.I. carried out the 1 100V cabling required for the jetty lighting, as part of their Coolkeeragh contract.

In all, the cabling installed on this second contract included 7 083yd of 33kV PLYS cables of single-core and 3-core H and HSL types, a short length of 11kV cable, nearly 5 000yd of 1·1kV multicore PLYS, several hundred yards of 250V VIRLC cable, and 3 200yd of telephone (pilot) cables.

It is of interest to note that A.E.I. Construction Division engineers also carried out the cabling of the Carbide Industries works last year while Coolkeeragh power station was still under construction.

Travel Boom Stays

THE BIG TRAVEL boom on the Kent coast lines, electrified a year ago, continues. (A.E.I. cables serve these lines.)

In the first nine months that the new electric trains were running (from 15 June to 13 March) 4 143 000 tickets were collected at stations in the area—36% more than the figure of 3 032 000 for the same period ending in March 1959.

Ticket sales in the area were up by nearly one-third. **Theories that the spectacular increases were due mainly to an exceptional summer last year were disproved by the winter figures.**

In November, for instance, the overall increase of ticket sales in and to the area over November 1958 was more than 30%.

And in February, ticket sales to other stations in the newly electrified area were up by 155% at Teynham and 68% at Faversham.

Mr V. J. Stock (President, E.C.A.) presenting his address with (*left to right*) Mr C. R. Waterhouse (President elect), Councillor John Kennedy, J.P. (Mayor of Scarborough), and Mr L. C. Penwill, C.B.E. (Director and Secretary, E.C.A.).

The E.C.A. Conference at Scarborough

THE 1960 GATHERING of electrical contractors took place at Scarborough during 19 to 21 June. On Monday, 20 June, after a civic welcome by the Mayor and the reply of the president of the Association, Mr V. J. Stock, the presidential address was delivered.

Mr Stock spoke of overseas trade and its dependence on a healthy and profitable home trade. It was his view that the inability of trade organizations over the last two years to control prices and discounts presented the greatest problem which the electrical industry had ever had to face. Self-discipline was necessary if future development was not to be jeopardized, and he briefly referred to the conditions in the cable industry as a "cogent example of the breakdown of commercial discipline . . . the situation was unquestionably aggravated by the contractors endeavouring to score over their competitors by demanding greater and greater discounts."

The Fair Trading Council, he said, was on the verge of liquidation, but manufacturers, wholesalers, and retailers alike should strive to keep alive the principles which it had laid down during its thirty years of existence.

Mr Stock, reviewing the activities of the Association during the year of his presidency, mentioned the work of the Association's Electrical Retailers' National Committee which has issued a successful Retail Brochure and a Used Price List of major domestic appliances. Consideration was being given to a service designed to give sales training and showroom organization instruction and, within the last few days, arrangements had been completed with a banking house which would enable members to compete with the hire-purchase terms offered by departmental and chain stores.

The president spoke of co-operation with other bodies where the Association was playing its full part, and its concern with the unfairness of fixed price contracting which did not take into account fluctuations of the price of goods and labour with time.

The problem of labour—its claim for a shorter working week which would in all probability result in no appreciable increase in production, yet would increase costs unless operatives really co-operated and worked to the actual times for which they contracted their labour—was another matter to which the president referred.

Before he concluded his address, Mr Stock had sound words to say on the electrical industry as a whole: ". . . in my opinion," he stated, "no section can stand alone, and I am convinced the time has arrived when there shall be an effective forum of all interests in the electrical industry, whereby the free exchange of views, mutual co-operation, and understanding can be engendered, and greater service can be rendered to the general public at home and to our markets overseas. I would therefore urge all sections of the industry to support the move now being made to bring such a forum into active and effective fruition."

In conclusion, the president expressed his thanks to his helpers, especially to his wife and to Mr L. C. Penwill, the Association's Secretary.

New President

Discussions on each paper followed their presentation and, after discussion of the second paper, Mr V. J. Stock introduced his successor to the Conference—Mr C. R. Waterhouse, president of the Sheffield Branch 1959–60. In a short speech Mr Waterhouse mentioned the E.C.A.'s sixty years of existence and requested members' support during his presidential year.

ABSTRACTS FROM PAPER 1:

Retailing—The Future Pattern

By NICHOLAS A. H. STACEY

Due to the absence of change for several decades the pace of retailing progress has been all the more rapid in the 1950s. Today, on the threshold of the 1960s, the tempo of change is still not slackening, and forward-looking business men must scan the horizon if they are not to be caught unawares.

What we must examine is which new forms of retailing suit us best as a nation and how they can be adapted or improved to serve our best interests. But the most vital question before us is—why should we innovate?

It must be understood that the need for change is imposed from the demand side—from the consumer end. Mass consumption demands that distribution channels be reshaped and as a nation we must continue to streamline our retail trading organization and strive for added efficiency.

The adaptation of labour-saving devices in retailing is costly and if it had not been for the innovations in self-service and supermarket facilities the percentage increase in distributive employment would have been higher than the 19% increase which occurred between 1948 and 1958.

In the radio and electrical goods trade, available data show that while in 1950 the multiples' turnover was over one-third of the independents', by 1957 it was more like two-fifths. Nevertheless, the average sale per outlet in the independent shop in 1957 was 2·3 times larger than in 1950 compared to the multiples' 1·8.

While the small man increased his profit margin by 0·7% in the seven years under review, the big chains increased theirs by 6·9% or almost ten times as much as the small man.

Stock turnover of the small radio and electrical establishment rose from 5·3 times to 6·0 between 1950 and 1957, that of the multiples' declined from 6·5 to 5·1. Thus while the small firm used its capital more efficiently than the big firm, the profit margin increases of the small firm still did not compare favourably with those of the large firm. The inference we must draw from these facts is that the small shop is often a high cost distributor and that the large shop is often a lower cost distributor.

Bigness has inherent advantages whatever the nature of the organization. The facts are that the real competitors of the small men are the chain stores. There is no denying that the multiples are better merchandisers, and often offer keener prices than the sole trader. Basically, therefore, it is an inexorable law of business that they should continue to grow faster.

The most meaningful portent in British retailing in the 1950s has been the appearance of the self-service store and the supermarket. One of the largest supermarket chains in Britain claims 12% of its turnover in non-food lines. There is little doubt that certain kinds of electrical goods will be increasingly sold in self-service stores and supermarkets in the 1960s.

Wholesaler service can be a big factor in the successful trading of the small retailer. McKesson and Robbins, New York, perhaps the largest drug wholesalers in the world, claim that they helped one out of every five drugstores to modernize in the past five years. They have even provided the right kind of shop fixtures.

There are two types of voluntary purchasing groups in Britain which enable retailers to take advantage of better terms, superior supplies, and reduced cost, by improved wholesale organization. One is operated by the retailers themselves, and is termed the "retailers' co-operative", the other is the "voluntary purchasing group", which is operated by the wholesaler. Both have come to us from the U.S.A.

Finally, what about the manufacturers helping the retailer? The lot of the small retailer is much lightened by the significant help given by the manufacturer in being responsible, almost *in toto*, for the promotion of his merchandise and for creating public demand for it. The maker can further help the retailer by advising him on the results of his market research, and also by encouraging trade by making credit available at competitive rates.

In conclusion, the small retailer must realize that modernization of premises, up-to-date methods of display, and skilled salesmanship are just as much needed by him as by the multiples which have long adopted these techniques. There are real opportunities for him if he adapts himself—but adapt himself he must!

ABSTRACTS FROM PAPER 2:

Electrical Floor Warming

By R. D. JACKSON

If the contractor is to apply himself successfully in the new field of floor warming he must somehow equip himself with adequate knowledge of the subject and available equipment, or take advantage of the services offered to him by manufacturers.

The floor-warming manufacturer's technical service is, of course, part of his sales effort. A code of practice for electrical floor warming is at present under consideration.

All floor-warming systems, whether directly embedded or rewirable, whatever the type of element or tubing, will produce the same result for the same operating conditions. The only variation is in equipment cost.

The use of floor warming to provide full comfort depends on the heating requirements, and this is indicated by the building construction. This is because the amount of heat given off from the surface of a floor is related to the difference in temperature between the floor surface and the room. Approximately 0·5 watt per sq.ft is transmitted for every °F. of such difference (1·7B.t.u. per sq.ft per °F.).

Floor surface temperatures are, of course, also related to floor finishes, since some of these might soften if used at the higher temperatures recommended, whilst others might be laid with a bedding compound affected by temperature.

If a manufacturer's assistance is being sought, it is best to issue a brief specification and the following clauses should ensure all relevant factors being taken into account. The specification should include the comfort effect required, "U" values, scope of system, the working margin for restricted intake operation, intake hours, supply voltage, floor surface temperature limits, heating load, type of supplementary heating, and expected consumption.

Intake hours for multi-storey buildings should include for a midday boost with the main intake between 7 or 9p.m. and 7a.m. The midday boost is also a general requirement for single-storey structures. Air temperatures should not fall more than 3°F. below the specified level during occupancy.

The rewirable system allows removal and replacement of the heating elements without disturbing the building structure, using tubes or ducts and transverse trunking. Its cost is affected by layout, and jointing methods vary with different manufacturers. The system normally requires a minimum depth from top of sub-floor to finished floor level of 2¼in. This includes for a maximum thickness of 1in. for actual floor finish.

Directly embedded systems employ an element suitable for burying solidly in the floor screed, and they are generally cheaper than withdrawable systems. Element types vary, and joints or the equipment for making joints are supplied by the manufacturer. These systems normally require a minimum overall depth from top of sub-floor to finished floor level of 2in. (including a maximum of 1in. for actual floor finish).

Air thermostats offer the best means of control. Floor thermostats should be used only as limiting devices in respect of floor temperatures.

Delayed intake can be achieved for relating the use of the system to the weather by means of external controllers. The use of these expensive controllers should be confined to buildings with a normal daytime period of occupancy as the comfort level will fall in the evening owing to the delayed intake.

There has been a serious shortage of efficient fault-finding equipment for use with embedded systems. The position will shortly be eased when the instrument developed by Mr Arkinstall, of the Midlands Electricity Board, who has been specializing in this field over the last few years, is in production.

Never lay today where floors will be screeded tomorrow. Before laying, elements should be checked for insulation resistance and circuit. During laying, the elements should be monitored until screeding is completed. It follows that element laying should not commence unless a repair kit is available on site.

In multi-storey buildings, sound insulation laid below the heating equipment may result in bad encasement of the equipment in the screed, as it can be pushed down into this insulation. The use of more rigid types of insulation would reduce this possibility, but it would be preferable to place the insulation on the underside of the slab.

Floor coverings used in domestic premises can vary considerably in their effect on heat output. Supplementary heaters used to boost evening temperatures will affect the floor thermostat, resulting in less than full intake and low temperature the following day. It is recommended that in multi-storey flats the problem be overcome by providing a good background temperature, say 55°–60°F., omitting thermostats, and controlling the installation by time switch and external controller. Tenants could then boost to suit their personal requirements without affecting the floor-warming system.

The high cost of incorporating external controllers in single domestic premises could be obviated if a control unit were to be devised graduated with the winter months *October* to *April* and adjustable for *normal*, *mild*, and *cold*. A time switch could be modified to suit.

Perimeter insulation applied to small rooms will reduce annual electricity consumption by approximately 10%. The whole question of perimeter insulation requires careful thought before application, particularly to domestic premises. A 10% saving in consumption on a load of only, say, 4kW for living-room and kitchen, represents about £2 10s. 0d. per annum. The mortgage repayment and interest on the additional capital cost involved could easily be more than this.

The important thing to the client is annual outlay, not electricity consumption as such. The position will be most critical in low off-peak tariff areas.

The full paper gives much useful information which includes tables of common "U" values, comfort levels, recommended floor temperatures for various floor finishes, percentage upward transmissions, vertical heat flow in suspended floors, heating loads, and calculations for laying out embedded systems.

Mrs Parsons, Mr and Mrs L. C. Penwill, Mr and Mrs V. J. Stock, and Mr H. D. Parsons (General Sales Manager, A.E.I. Cable Division).

Letter to the Editor

Graphical Symbols for General Electrical Purposes

SIR,—Whilst not wishing to detract from Mr Salzmann's advocacy of elementary (schematic) diagrams with separated representation contained in his article published in the May edition of *Distribution*, I would however like to draw attention to its lack of conformity with the British and, indirectly, the international standards.

This lack of conformity stems mainly from the use of Table 1—Abbreviations for Circuit Components—which is contrary to the code letters published in the British Standard B.S. 108. The appendices of B.S. 108 do, in fact, illustrate the same principles as emphasized in Mr Salzmann's article.

A committee is at present working on the amalgamation of B.S. 108 and B.S. 530 with a view to resolving the various inconsistencies between the two publications and also introducing certain internationally agreed standards, but it is unlikely that any great change will be made in the code letters at present published in B.S. 108.

Yours faithfully,

West Kirby, Cheshire. J. S. EKBERY

E.I.B.A.

AT THE ANNUAL general meeting of the Electrical Industries Benevolent Association it was stated that the Association's annual income, apart from legacies, was increased by £6 265 in 1959 to £81 428.

This increase, however, was necessary as the number of people who come to the Association for help increases annually and 1959 was no exception. Although all the aid given is not in the form of financial help as such, nevertheless such help may cost quite a lot of money. Its value, in terms of relief and kindness during times of trouble to those who have benefited, is incalculable.

Subscriptions are still required for this charitable work. We are pleased to acknowledge with thanks the following subscriptions.

1960 Subscriptions

Messrs E. J. Vidler, £5 5s. 0d.; A. T. Winder, £2 2s. 0d.; A. V. Burnett, £1 1s. 0d.; B. N. Purdie, £1 1s. 0d.; F. J. Backlog, £1 1s. 0d.; G. Reeves, £1 1s. 0d.; A. S. Brewer, £1 1s. 0d.; S. J. Wilson, £1 1s. 0d.; V. B. Twiss, £1 1s. 0d.; J. Bevan, £1 0s. 0d.; E. S. Bantin, £1 0s. 0d.; H. C. Hoban, £1 0s. 0d.; G. O. Allerston, 10s. 6d.; L. F. Capeling, 10s. 6d.; E. S. Gilronan, 10s. 0d.; W. H. Seager, 10s. 6d.; C. H. Weymouth, 10s. 6d.; H. J. Annis, 10s. 0d.; L. Rivett, 10s. 6d.; F. Davis, 5s. 0d.; I. G. McArthur, 5s. 0d.; S. H. Wilkins, 5s. 0d.; J. H. Savage, £1 1s. 0d.; J. C. Duggan, £1 1s. 0d.

Covenanted Subscriptions

Messrs S. E. Goodall, £2 2s. 0d.; F. Bull, £2 2s. 0d.; J. Nicholson, £1 1s. 0d.

Simple Soil Classification

UNDER THE HEADNIG *Soil Classification for Cable Engineers* the Electrical Research Association has issued ERA Report, reference F/T198, by M. V. Vanner, M.A.—price 10s. 6d., postage extra. The report proposes a very simple system of soil classification by visual and tactual examination, and is intended to aid on-the-spot judgements as against the complex civil engineering tests which require skilled laboratory work.

A carefully controlled trial of the system has shown that it provides a valid method of classifying and identifying those types of soil of interest to cable engineers into broad divisions determined by the basic structure of the soil. The system can provide a uniform terminology which may be used when cable sites are being investigated.

Soil thermal properties play an important part in the control of the loading capacity of buried power cables and will become of even more importance if greater use is made of the cables, as rigorous control of the cable environment will have to be maintained. The use of this simplified system of soil classification should advance the time when cable engineers will be able confidently to predict the behaviour of the soil environment of buried cables.

The system may also prove useful where a uniform terminology can be used with advantage in other fields—such as the construction of overhead lines.

Electric Power in Europe

AN OVERALL PICTURE of electric energy supply is given by the July *Quarterly Bulletin of Electric Energy Statistics for Europe*. The Bulletin is in three languages: English, French, and Russian. It gives figures for net production by thermal, hydro, and nuclear generation, with particulars of international power exchanges where such take place. Figures for the United States are included.

All statistics are tabulated in a standard form. Power figures for public supply undertakings and self-producers are tabulated separately, and separate figures are also given for Italy's geo-thermal production.

Problem Circle

ALTHOUGH IT WAS hoped to commence a new series of problems in our new journal for the enjoyment of our readers, it has not been possible to include any in this issue. Owing to the redesigning of the layout and delay in publication, difficulties would have arisen in fixing a "closing date" to any competition included in this issue.

We hope to recommence this popular feature in a future issue. Meanwhile, we extend an invitation to readers to send us any problems which they think will be of interest to their fellow puzzlers. A payment will be made for each problem used in Problem Circle.